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The Director

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Washington, D. C. 20505

Executive Registry

77-5791/A

DIA

7 November 1977

MEMORANDUM FOR: Acting Director, Defense Intelligence Agency

SUBJECT : CIA Comments on DIA Critique of Soviet Oil Prospects

REFERENCE : Your memorandum, dated 12 Sep 77, Differences in CIA/DIA Appraisal of the Soviet Oil Situation

1. I very much appreciate DIA's effort to further knowledge and understanding of the prospects for Soviet oil production. This issue is clearly a critical one, both because of its importance to the economy and policies of the USSR and because of its far-reaching implications for the international supply of oil and our relations with the Soviets. There has been too little serious research on this question, and I want to strongly encourage you and others to pursue the matter as one of the highest priority.

2. CIA's Office of Economic Research has prepared the attached comments on your critique. As you are aware, CIA has put a major effort on the Soviet oil question and built a strong team of Soviet and energy experts. Earlier CIA estimates of Soviet oil prospects were in general agreement with your current estimates. The new estimate, which is considerably more pessimistic, results from a thorough evaluation and updating of all evidence available to us. Although no one can have a high confidence in any prediction a decade ahead, the CIA people tell me that they find no basis for changing their estimate.

(EXECUTIVE REGISTRY)

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STANSFIELD TURNER

Attachment:
As stated

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CONCURRENCE	INFORMATION	SIGNATURE

Remarks:

NFAC 2837-77

- 1 - 2: Attached are OER's comments on DIA's critique of CIA's Soviet oil estimate for transmittal to Lt. Gen. Aaron, Acting Director, DIA.

FOLD HERE TO RETURN TO SENDER

FROM: NAME, ADDRESS AND PHONE NO.	DATE
OD/OER 4 F 18 Hqs. 	31 Oct 77
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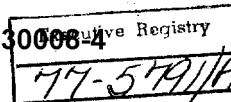
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Central Intelligence Agency

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Washington, D. C. 20505

7 NOV 1977

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/s/ Stansfield Turner

STANSFIELD TURNER

Attachment:
As stated

-2-

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27 October 1977

MEMORANDUM

SUBJECT: Comments on DIA Critique of CIA Estimate of
Impending Soviet Oil Crisis

1. DIA is unequivocal in judging the validity of our analysis of the outlook for the Soviet oil industry, claiming that a review of the evidence reveals nothing which corroborates the CIA assessment. At the core of the DIA critique are the following main points:

- o Given the Soviet record in meeting planned production targets, it seems prudent to accept their projected 1980 goal of 620-640 million tons as attainable.

- o Soviet proved reserves total 60-75 billion barrels rather than the 30-35 billion barrels CIA estimates.

- o The Soviet Union does not have a fluid lift problem, which, in the CIA analysis, is overstated because of a methodological error.

- o The Soviet Union does not have a severe drilling problem, since the drilling program now devoted to gas can be shifted to oil exploration.

Aside from these specific points, DIA further argues that large investments being made to expand West Siberian pipeline facilities constitute additional evidence that the Soviets can meet planned production targets for 1980 and beyond.

Soviet Oil Plans and Accomplishments

1. Soviet performance throughout the 1950s and 1960s was one of successful fulfillment of annual and five-year plan goals for oil production. Since 1971, however, annual goals have not been met, even though West Siberian output goals were exceeded. For example, during 1971-75 total overfulfillment of oil production from West Siberia amounted to almost 880,000 b/d, but was offset by shortfalls in older

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producing regions. Thus, if West Siberia had not surpassed the original target for 1971-75, national oil output in 1975 would have been about 8.94 million b/d rather than the 9.82 million b/d actually recorded.

2. Indeed, the consequences of this West Siberian overproduction are at the core of our analysis. The decline in the output from older fields in the Western regions is continuing to be more rapid than the Soviets expected, a factor which DIA apparently does not take into account.

3. Soviet oil production during the remainder of the 1970s and into the 1980s will depend heavily on the increased development of West Siberian deposits. After the giant Samotlor oilfield reaches its planned peak production in 1977-78, all of the planned increase in output will have to come from smaller fields in West Siberia. In 1976, seven new deposits were brought into production, but their total contribution to output growth was less than 300,000 b/d, compared with 280,000 b/d for Samotlor alone. Soviet sources indicate that peak production can be maintained at Samotlor for only about 4 years, and the DIA assessment provides no insight into how an eventual decline at Samotlor will be offset.

4. There is an analogy between the CIA forecast of oil developments in the Soviet Union and recent oil production history in the United States. In the US, domestic oil production declined about 1.5 million b/d between 1971 and 1976, after the reserve to production ratio fell below 10:1.* For the Soviet Union, CIA is projecting a peak in oil output after 1978 and a subsequent decline in production similar to the one which occurred in the US after 1971.

Reserves

5. Neither exploratory drilling meterage nor claimed finding rates support a reserve estimate as high as DIA's 60-75 billion barrels. According to Soviet sources, total

* A reserve to production ratio (R/P) of 10:1 is a minimum level considered essential in planning for growth in oil production. It is widely held that an R/P below this level will restrict growth and eventually bring about a production decline unless large additional discoveries are made.

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exploratory drilling amounted to 80 million meters during 1946-75. National Petroleum Council (NPC) experts, in studies published in 1962 and 1964, calculated finding rates of 120-150 tons per meter in the USSR in the 1950s. Finding rates have clearly fallen since the early 1960s.

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6. We believe that our estimate of proven reserves is liberal because the well-publicized "write off" -- the periodic downward revisions of reserve estimates by the Soviets themselves -- is not taken into account. These write-offs could reduce estimated reserves as much as 25 percent. Our results agree with oil reserve estimates published by Dr. R.W. Campbell (University of Indiana) for 1960 and subsequent indicators of reserve growth.

7. Soviet literature indicates that proved oil reserves (A + B) declined in 1971-75, as production exceeded gross additions to A + B reserves. Apparently, the situation has continued to deteriorate, since reserve targets were not met in West Siberia last year or this year according to Pravda (10 Aug. 77). Moreover, the author of the same Soviet article said that the failure to meet reserve targets would adversely affect the industry in the near future. This statement is not consistent with a reserve estimate as high as 60-75 billion barrels.

8. Oil Minister Shashin and other high officials have often stated that continued expansion of the petroleum industry after 1975 required the discovery of whole new oil provinces similar to West Siberia. Again, this is not consistent with DIA's high level of proved reserves. Unproved reserves cited by DIA as 438 billion barrels are not relevant to discussions of production in the near term. Unproved reserves will only become relevant when they are confirmed by drilling. We do not know whether 438 billion barrels is conservative or optimistic, although we note that it is more oil than has been found and proved in all the Persian

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Gulf countries combined. Only about 150 billion barrels have been found in the United States in the entire history of the industry.

Drilling Requirements

9. We disagree with DIA on the adequacy of Soviet drilling capacity. We believe drilling capacity will be a constraint on Soviet oil production for the following reasons:

- o The number of drilling rigs has been and will probably continue to be, about constant in spite of rising production of rigs because of the very large replacement demands.

- o There are few, if any, opportunities to shift rigs from gas to oil exploration because most gas exploration rigs are already being used for oil.

- o Rig productivity (meters drilled per rig) will increase, but not enough. The increase from 1971-75 required to fulfill the 1976-80 plan is 42 percent, whereas it was only 17 percent from 1966-70 to 1971-75. Moreover, drilling conditions will become much more difficult (for example, drilling in West Siberia, where conditions are harsh, is to rise from 9.5 million meters in 1971-75 to 30 million meters in 1976-80).

- o Finally, oil recovery rates will fall, as no new giant fields have been discovered.

10. We agree with DIA that total meterage drilled has increased in each Five Year Plan since 1960. DIA fails to note, however, that exploratory drilling -- including drilling for gas -- has remained constant at 25-26 million meters in each period. Exploratory drilling by the Oil Ministry itself has declined in absolute terms, and its share in total drilling has fallen sharply, dropping from 40-50 percent of total meterage drilled in 1960 to only about 20 percent last year (see the Table). The decline basically reflects the increased emphasis given to development drilling. This shift has accelerated since 1970 in order to sustain gains in production at a time when depletion offset requirements have been mounting. "Depletion offset" is a Soviet concept to define the new capacity required to offset the decline in output from existing wells. Soviet technical literature clearly states that depletion, in this sense, has been growing in recent years, indicating that an increasing proportion of wells is in

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USSR: Drilling by the Ministry of the Petroleum Industry
(000 Meters)

<u>Year</u>	<u>Exploratory</u>	<u>Development</u>	<u>Total</u>
1966	3,347.1	5,598.3	8,945.4
1967	3,374.3	5,860.4	9,234.7
1968	2,926.5	5,866.9	8,793.4
1969	2,667.9	6,040.8	8,708.7
1970	2,830.9	6,198.3	9,029.2
1971	2,952.6	6,291.5	9,244.1
1972	2,903.6	6,951.0	9,854.6
1973	2,868.2	7,677.4	10,545.6
1974	2,920.7	8,059.7	10,980.4
1975	2,732.6	8,927.1	11,659.7
1976	2,545.8	9,521.0	12,066.8

Source: БУРЕНИЕ, вып. 9, сент., 1977, стр. 4. (Н. А. СИДОРОВ, И ДРУГИЕ, "ОСНОВНЫЕ ДОСТИЖЕНИЯ В ОБЛАСТИ БУРЕНИЯ НЕФТЯНЫХ СКВАЖИН ЗА ПОСЛЕДНИЕ ГОДЫ.")

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the stage of declining output. The Soviets recognize this trade-off between development and exploratory drilling but continue to opt for the former. Only improved drilling rates will solve the problem, and drilling is the most backward sector of the Soviet oil industry.

11. Not only are development drilling requirements continuing to rise rapidly, but exploratory drilling must be increased sharply to locate and prove reserves to support production in the 1980s. By that time, output in the old Urals-Volga fields will be falling rapidly, and production at Samotlor and other major West Siberian fields will have begun to decline.

12. The Soviets use three types of drilling equipment: turbo drills, rotary drills, and electric drills. About 80 percent of Soviet drilling rigs are turbo rigs. The remainder are mostly rotary rigs roughly comparable with US equipment produced in the early 1950s. The electric drill has been tested extensively but technical problems persist. Despite the growing need for drilling, the Soviet rig park has remained essentially unchanged at 1,800 deep well rigs. The down-hole turbines used in turbo drilling have a relatively short life, about 600 hours. Because of the abrasion caused by drilling fluids, turbine vanes wear out quickly. Bearings also wear out rapidly from the harsh operating environment. In 1975, Soviet production of turbine sections was slightly less than 10,000, which implies that each operating rig requires reequipping with new turbines every six months.

13. Since 1960, with the move to West Siberia and the need to drill to greater depths in nearly all regions of the USSR, commercial drilling speed of exploratory rigs has fallen by 15 percent. Because of the decline in rig productivity, the USSR will have to boost its active rig park just to maintain present amounts of annual drilling, let alone meet future increased drilling requirements. Moreover, the decline in rig productivity probably will accelerate as a larger share of total drilling takes place in Siberia, where wells are deeper than in the Urals-Volga fields and rig transport between wells is more costly and time consuming.

14. No evidence is available, however, to indicate that the Soviets have planned or have the capacity to boost their rig supply sharply. As late as 1976, Oil Minister Shashin said that rig productivity would have to

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rise by 42 percent during the current plan period if the 1980 output goal is to be met. The number of meters drilled annually in the USSR is roughly one-fifth that achieved in the US with approximately the same number of rigs. Large amounts of improved equipment and skilled operating crews will be required to upgrade the Soviet capability. Even if the USSR decides to reequip its drilling sector with massive imports of Western equipment, adequate supplies would not be available for years, in part because of order backlogs by Western purchasers.

15. The Soviets will be unable to shift rigs from gas to oil development. Almost all the rigs allocated to the gas industry are needed for the large increase in gas production called for in Soviet plans. Few rigs are being used for gas exploration. In 1973 the Ministry of Geology was ordered to discontinue the search for gas in West Siberia and to concentrate on looking for oil. Even so, oil exploration targets have not been met.

Fluid Production and Fluid Lift

16. DIA is, of course, correct in basing the demand for pumps only on the amount of fluid to be artificially lifted. However, Soviet data lead us to conclude that DIA has greatly underestimated the volume of fluid (oil plus water) to be pumped in the 1980s. The volume of oil produced by free-flowing wells is expected to decline in the next several years because of rapid water encroachment in the oil-producing reservoirs. A recent Soviet oil journal (Neftyanoye Khozyaistvo, July 1977) indicated that more than 63 percent of total oil production is to be produced from wells employing artificial lift in 1980. This is an increase from 45 percent in 1970 and 55 percent in 1975. This source also gives the total water cut as 48 percent in 1975 and 53 percent in 1980. It is reasonable to assume (as does DIA) that the water cut in free-flowing wells will remain at about 13 percent, as during the past decade. From these data, we can calculate total fluid lift of 930 million tons in 1975 and 1.45 billion tons in 1980, and artificial lift of 690 million tons in 1975 and 1.18 billion tons in 1980 -- or well above DIA's forecast of 922 million tons. The Soviet estimate implies a modest increase of almost 2 percent a year in the water content of the fluid from 1975 to 1980, whereas the DIA assumes only about half a percentage point increase annually.

17. CIA believes, based on recent Soviet experience, that the water content in total fluid produced will rise more rapidly than Soviet planners have assumed -- about

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3 percent per year. Recent Soviet technical publications indicate that the water content of fluid recovered from West Siberian oilfields that have been in full production will increase 4-6 percent per year. The situation in older fields is probably at least as bad. The entire increase in our estimate of fluid lift over the implicit Soviet plan figure for 1980 would have to be artificially lifted. Thus, in 1980 some 1.5 billion tons of fluid would have to be pumped, out of a total fluid lift requirement of 1.8 billion tons (see Figure 3).

18. The DIA makes a linear projection of the artificial fluid lift requirements. It further assumes that the water content of fluid artificially lifted remains at 60 percent from 1975 to 1980 and then rises to 65 percent in 1985. As indicated above, Soviet plans imply a 67 percent water cut by 1980 and our forecasts are substantially higher. After 1980, moreover, the problem is bound to worsen unless giant new fields are found in accessible areas. Barring such developments, artificial lift requirements are almost certain to rise at a constant or increasing rate.

19. We are in general agreement with DIA's estimate of the numbers and capacities of pumps in 1975 and do not take issue with its projections of pump capacity, although there are many uncertainties in such a projection. DIA's projected pump capacity, however, would not meet CIA's projected fluid lift requirements even if all the pumps were fully used. Realistically, moreover, the short operating life of Soviet submersible pumps (6 months to a year on the average and less in some areas), the need to hold many in reserve for replacement, and the large downtime for repair are bound to substantially reduce capacity utilized.

20. CIA agrees that the overall water cut (the percent of water in total fluid production) did not increase much during 1967-75. What DIA apparently does not recognize is that several unique factors accounted for this relative stability -- factors which will not be important in the future.

a. First, the major Urals-Volga fields were in what the Soviets call "the second stage of production," where output is maintained relatively flat by infill drilling (drilling new wells in between oil wells). At this stage, wells that showed sharp increases in water production could be profitably abandoned or converted to water injection

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wells. The Soviet literature is replete with references as to how these fields (presently accounting for more than one-third of Soviet output) are now entering the "third stage of production," where oil output declines sharply while total fluid production rises, causing a sharp rise in the water cut. Figure 1 is from a 1976 Soviet publication and is typical of Soviet technicians' view of the outlook for the Urals-Volga region.

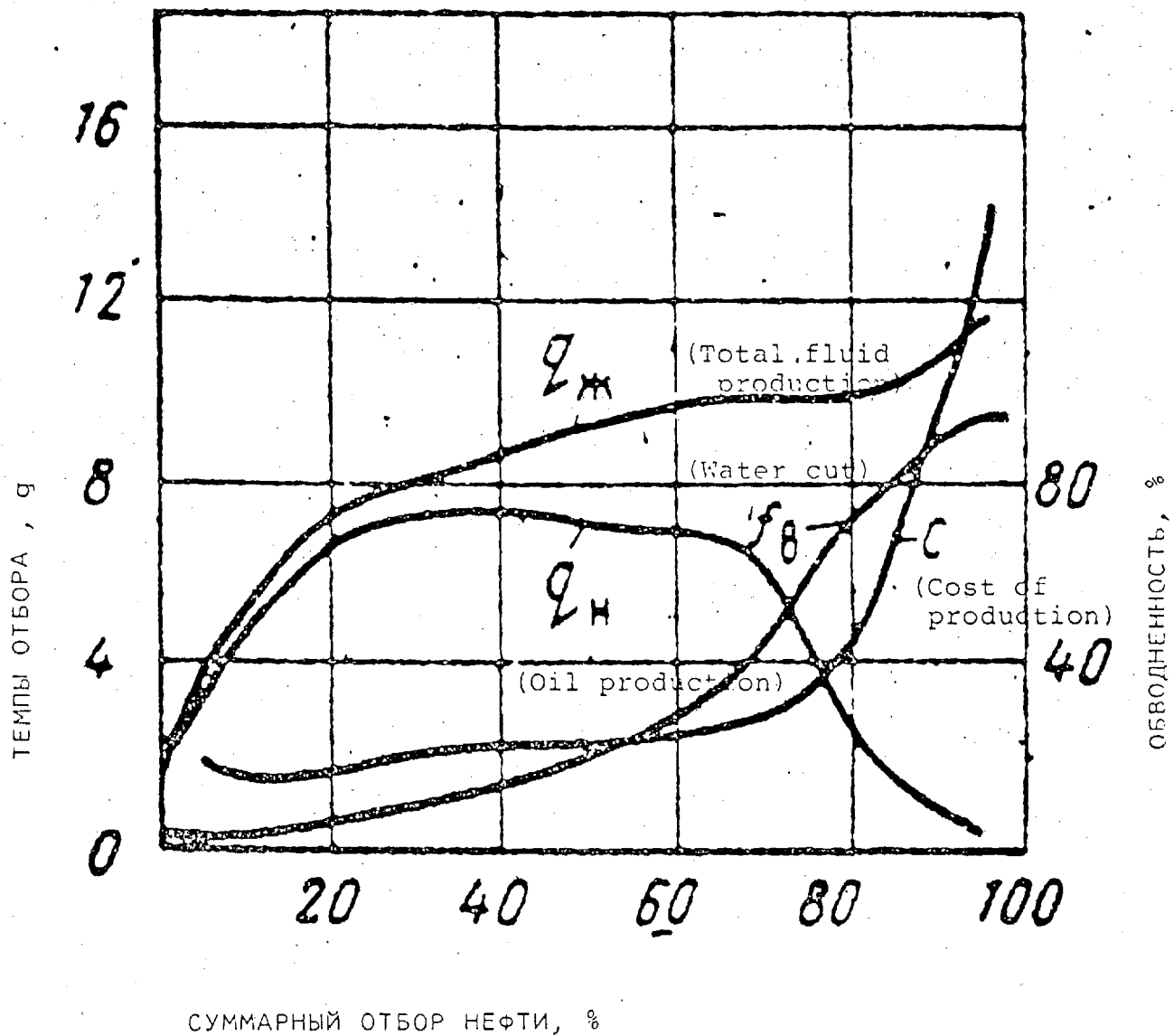
b. Second, the rapid development of new fields in West Siberia, where wells flow freely for a short period and where substantial water cuts begin about 2-5 years after production begins (in contrast to 10-15 years in the Urals-Volga), also held down the overall water cut during 1967-75. However, by 1975, the average water cut in West Siberia was rapidly approaching the average for the USSR as a whole. Figure 2, from the same 1976 Soviet publication, shows the rapid rise in average water cut for West Siberia as a whole (#1), as well as for important subregions, such as Nizhnevartovsk (Samotlor) (#2), Surgut (#3), Shaim (#4), and the Ust Balyk oilfield (#5). (The solid lines indicate average oil yield per well, while the dotted lines indicate total fluid.)

West Siberian Pipelines and Electric Power Facilities

21. We cannot agree with DIA estimates that the Soviets are expanding pipeline capacity in West Siberia to handle 400 million tons (8 million b/d) annually. The pipeline system presently in operation to transport West Siberian crude oil to the Urals and eastern Siberia consists of one 1,020 mm diameter and three 1,220 mm diameter lines with a total capacity of 252-276 million tons per year (5 to 5.5 million b/d). Construction of a fourth 1,220 mm diameter pipeline is due to get underway this fall from the oilfields at Samotlor to refineries in the western regions of the USSR and is to be completed by 1980. A line, listed by DIA to be built from Samotlor to Tayshet, will not be a separate pipeline but an extension of the existing pipeline from Samotlor to Andzhero-Sudzhensk to Irkutsk. Thus, by the end of 1980, total pipeline capacity to transport oil from West Siberia would be some 320-354 million tons (6.4 to 7.1 million b/d). Because of the Soviet welding techniques and delays in installing pumping stations, we believe that the lower range of the pipeline capacity (6.4 million b/d) is more likely. This figure -- 6.4 million b/d -- is consistent with Soviet plans to produce 6.0 to 6.2 million b/d in West Siberia in 1980, a target which the Ministry of

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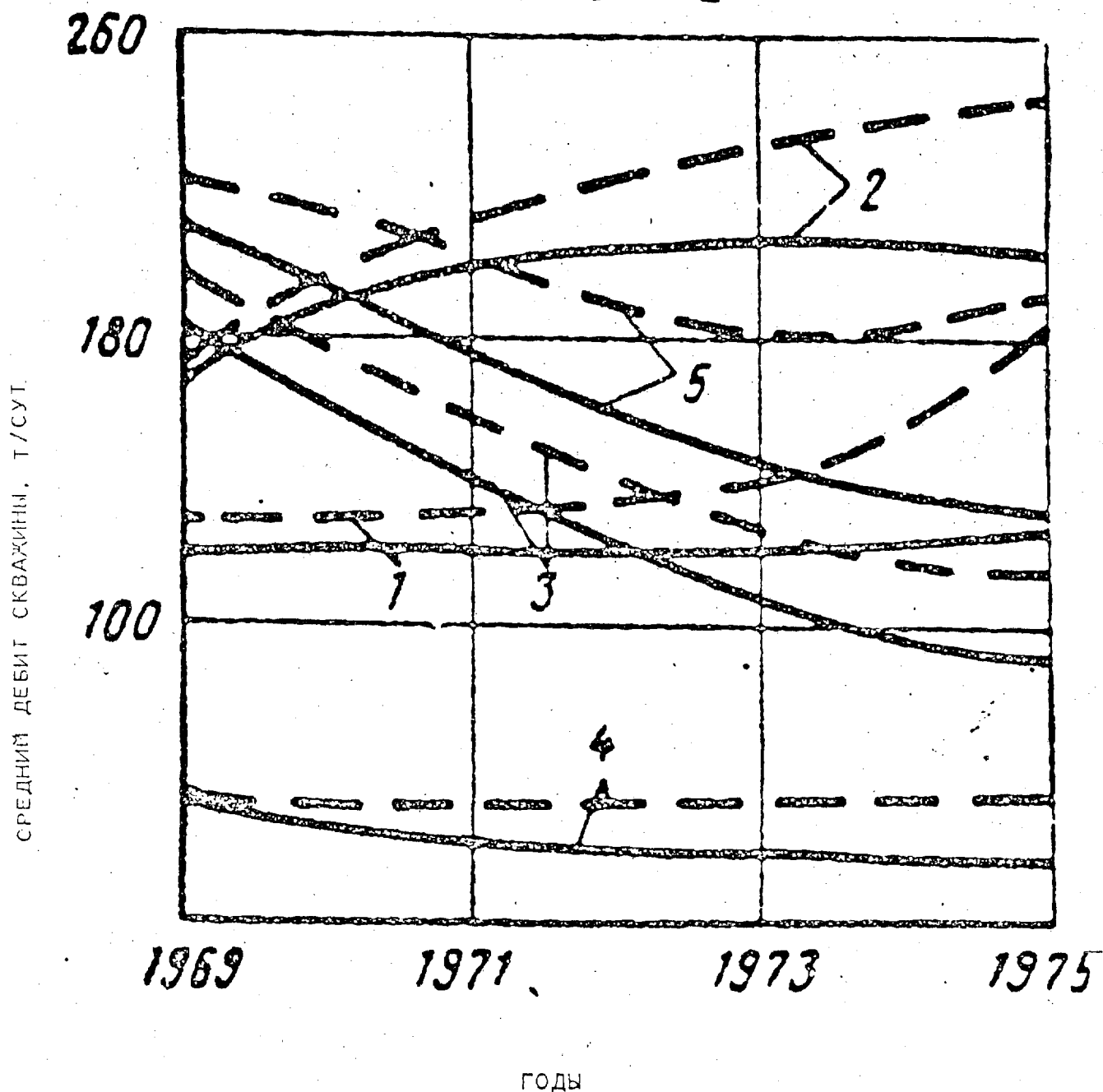
FIGURE 1
THE EFFECT OF WATER SATURATION OF PETROLEUM



SOURCE: В. П. МАКСИМОВ, ЭКСПЛУАТАЦИЯ НЕФТЯНЫХ МЕСТОРОЖДЕНИЙ В ОСЛОЖНЕННЫХ УСЛОВИЯХ. МОСКВА, ИЗДАТЕЛЬСТВО НЕДРА, 1976, СТР. 44.

FIGURE 2

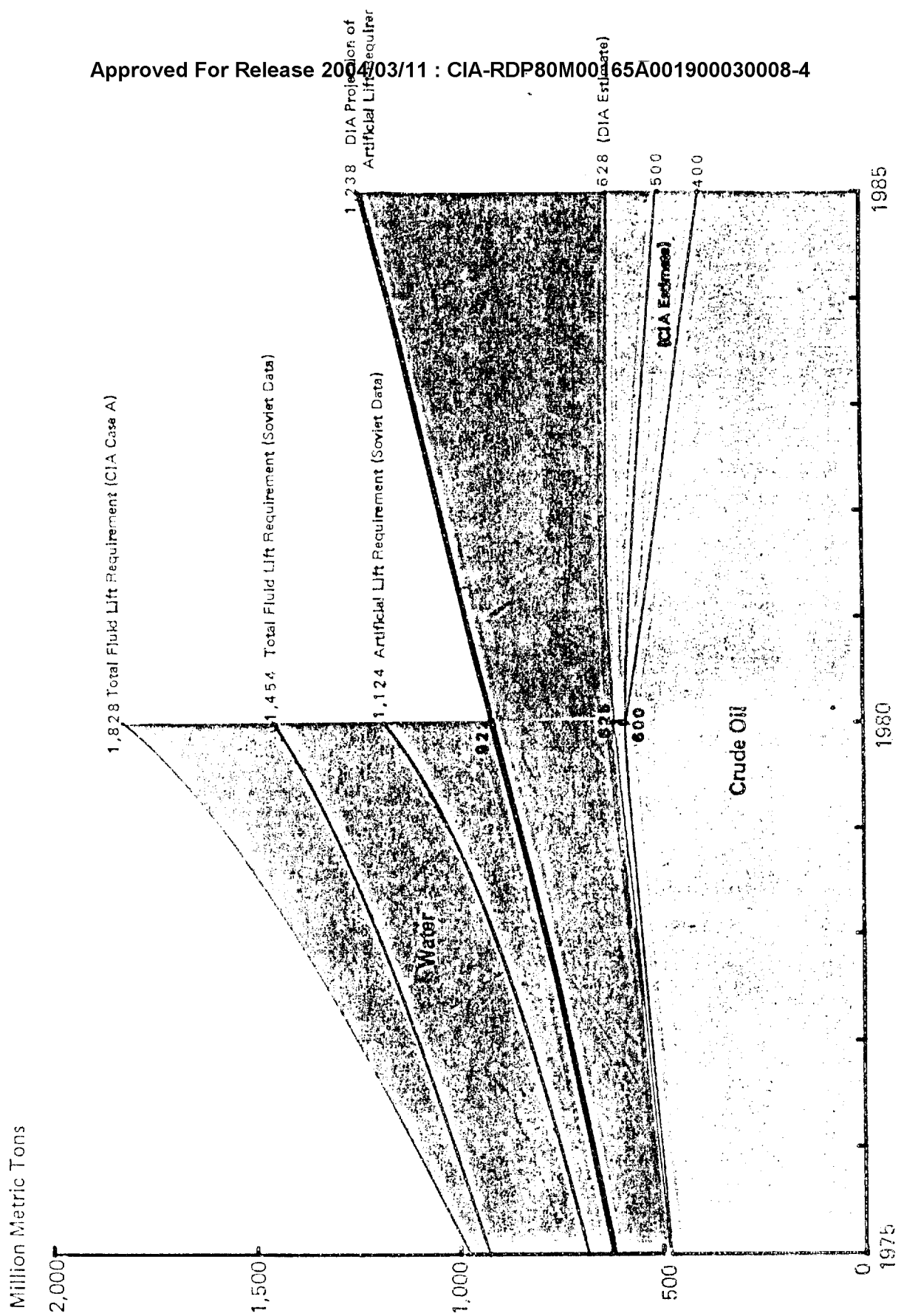
DYNAMICS OF AVERAGE YIELDS OF WELLS OF WEST SIBERIA



SOURCE: В. П. МАКСИМОВ, ЭКСПЛУАТАЦИЯ НЕФТЯНЫХ МЕСТОРОЖДЕНИЙ
 В ОСЛОЖНЕННЫХ УСЛОВИЯХ, МОСКВА, ИЗДАТЕЛЬСТВО
 НЕДРА, 1976, СТР. 51.

Figure 20

USSR: FLUID LIFT REQUIREMENTS



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Construction of Oil and Gas Industry Enterprises (responsible for pipeline construction) will strive to meet.

22. DIA overestimates the capacity of 1,220 mm diameter pipelines by 15-20 percent. Soviet sources reveal that the range of throughput for a 1,220-mm oil pipeline is 70-78 million tons, not 80-90 million tons that pipelines operating in Western countries can handle.

23. DIA states that the electric power network in the Tyumen' Oblast-Middle Ob' region of Western Siberia is under continuous expansion and is designed solely to support the fuels industry. Soviet literature is replete with references about the use of gas from this region to generate power for transmission to consumers in the Urals area. Moreover, the capacity of power plants projected by DIA for West Siberia in 1985 and 1990 is much higher than we can account for, either from Soviet plans or from other source materials.

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DIA Estimated Soviet
1980 Fluid Lift Requirements
(millions of tons)

Oil Production	630	
Less Gas Condensate	<u>15</u>	
	615	
Oil, Free Flowing	246.00	(40%)
Oil, Artificial Lift	<u>369.00</u>	(60%)
	615.00	(100%)
<u>Fluid, Free Flowing</u>		
Oil	246.00	
Water	<u>36.90</u>	
	282.90	
<u>Fluid, Artificial Lift</u>		
Oil	369.00	(40%)
Water	<u>553.50</u>	(60%)
	922.50	(100%)
<u>Total Fluid Production</u>		
<u>Weighted Ratio</u>		
Oil	615.00	(51%)
Water	<u>590.40</u>	(49%)
	1,205.40	(100%)

Figure 5

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